All-sky GMI Radiance Data Assimilation Global Products from GEOS system In Support of the GPM Mission

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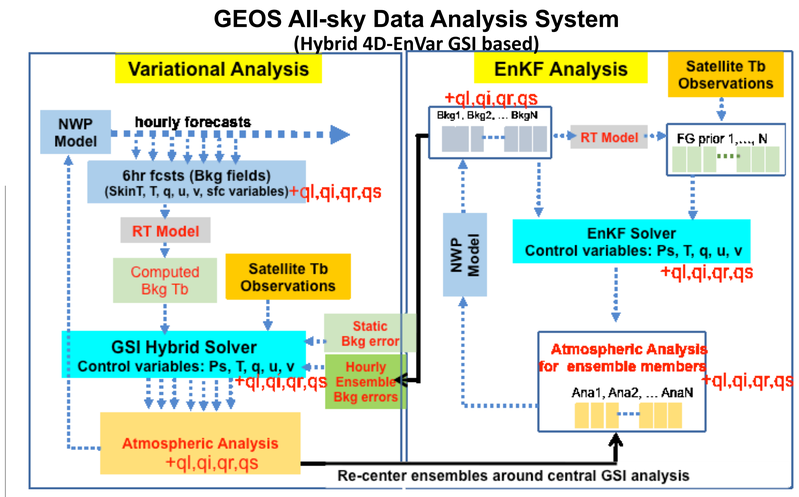
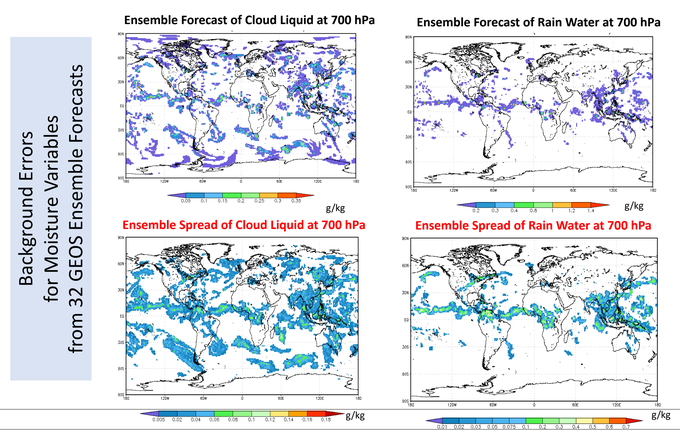
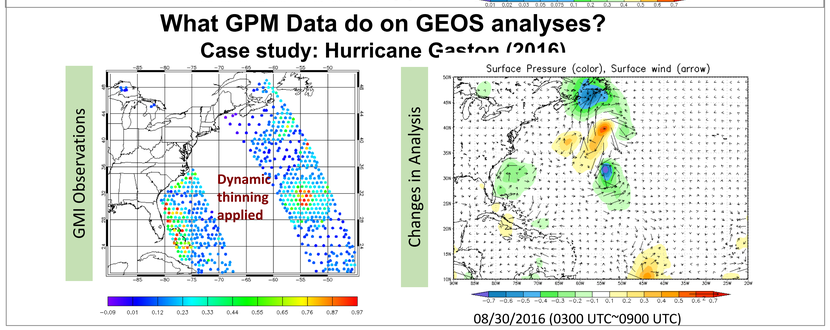
All-sky GPM Microwave Radiance Data Assimilation in GEOS

- **On 11 July 2018, the GMAO began assimilating Global Precipitation Measurements (GPM) Microwave Imager (GMI) observations into their Forward Processing (FP) System**. This all-sky system implements assimilation of GMI radiances in real-time. Active assimilation under all-sky situations, eliminates previous limitation to those unaffected by clouds and precipitation
- Advanced methods were incorporated to optimize the use of these observations such as adaptive thinning in the presence of clouds and precipitation, advances to underlying radiative transfer algorithm, incorporation of cloud ice, cloud liquid, rain, and snow into the solution.



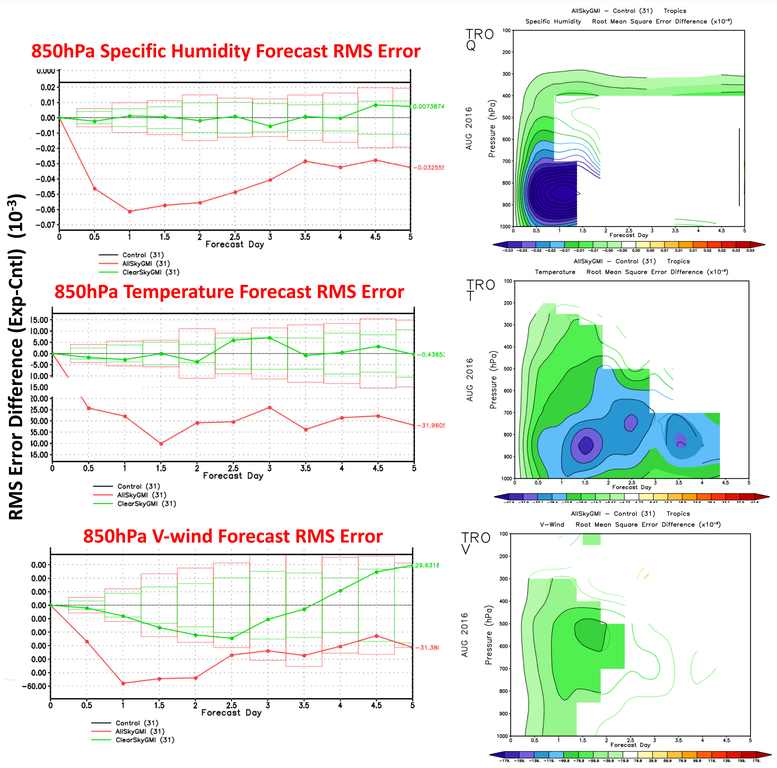




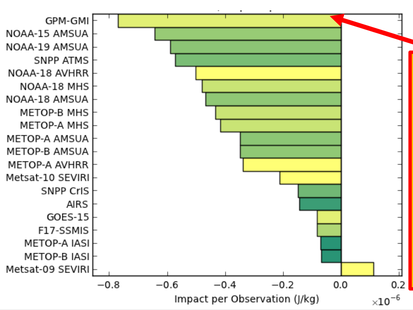
Impacts of All-sky GPM Data on GEOS Weather Forecasts

The addition of GMI radiances has the largest impact in the Tropics

- **Specific humidity is significantly improved in the short term (0-72hour) forecasts (See figures below).**
- **Similar improvements are seen in tropical mid and lower tropospheric temperature and winds. (See figures below)**
- Other modeling and initialization improvements included in the FP upgrade extend these improvements into the medium range.



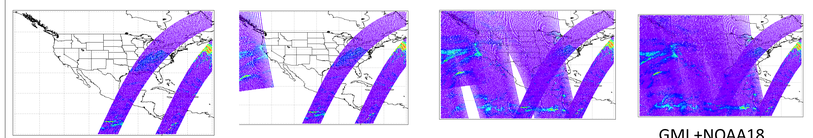
The GMI improvement is further seen via **the Forecast Sensitivity Observation Impact (FSOI)** metric. FOSI is a metric of how each observation contributes to the reduction (negative) or increase (positive) of the 24 hour forecast error.



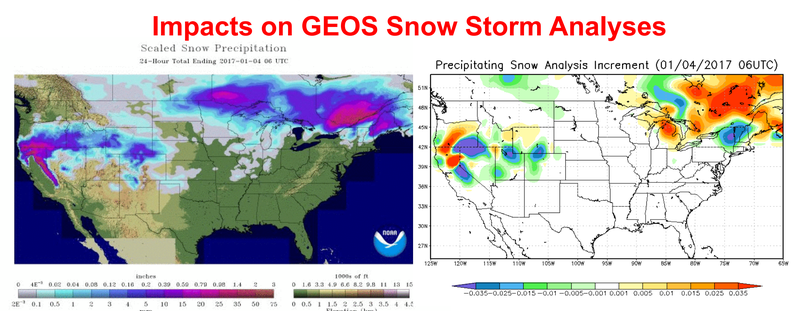
- **GMI is seen to have the highest impact per observation of all the radiance observation types (left) and the total impact of GMI is comparable to a single Microwave Humidity Sounder instrument.**

Extending All-sky System to All other Microwave Data

- To maximize the benefits, the all-sky system is being adapted **to assimilate more data from other microwave sensors** such as AMSR2/GCOME-W, Microwave Humidity Sounder (MHS), Advanced Microwave Sounding Unit (AMSU-A), and Advanced Technology Microwave Sounders (ATMS).
- We are currently enhancing **the all-sky system for better microwave data usage over land to improve forecasts of severe weathers including blizzards and floods.**
- In addition, this all-sky system is being used to generate GEOS Global Precipitation and Cloud Analysis products to support NASA Precipitation Measurement Mission (PMM).

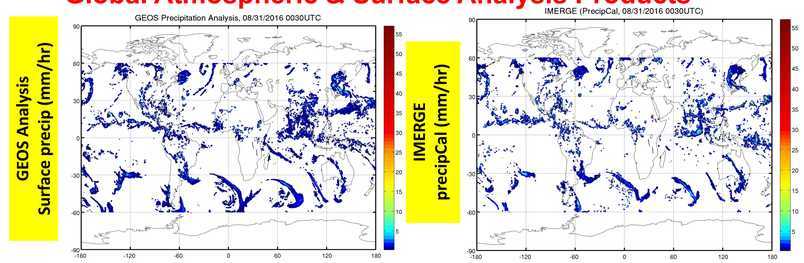


Impacts on GEOS Snow Storm Analyses



Preliminary results (movie above) demonstrate that assimilating microwave radiance data from GPM and several MHS sounders adjust precipitating snow during the winter storms and make GEOS analyses closer to the observations. Other atmospheric parameters like water vapor and surface pressure are also adjusted physically-consistent manner.

Prototype of GMI data+other satellite data assimilated Global Atmospheric & Surface Analysis Products



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